Ontario

Computer Programmer Analyst Program Standard

The approved program standard for all Computer Programmer Analyst programs of instruction leading to an Ontario College Advanced Diploma delivered by Ontario Colleges of Applied Arts and Technology (MTCU funding code 60503)

Ministry of Training, Colleges and Universities
February 2006

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Inquiries regarding specific Computer Programmer Analyst programs offered by colleges of applied arts and technology in Ontario should be directed to the relevant college.

This version replaces the program standard released in August 1998. Inquiries regarding this program standard should be directed to the address noted above.

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I. Introduction

This document is the Program Standard for all Computer Programmer Analyst programs of instruction leading to an Ontario College Advanced Diploma delivered by Ontario colleges of applied arts and technology (MTCU funding code 60503). This version replaces the one released in August 1998.

Development of System-Wide Program Standards

In 1993, the Government of Ontario initiated program standards development with the objectives of bringing a greater degree of consistency to college programming offered across the province, broadening the focus of college programs to ensure graduates have the skills to be flexible and to continue to learn and adapt, and providing public accountability for the quality and relevance of college programs.

The Colleges Branch of the Ministry of Training, Colleges and Universities has responsibility for the development, review, and approval of system-wide standards for programs of instruction at Ontario colleges of applied arts and technology.

Program Standards

Program standards apply to all similar programs of instruction offered by colleges across the province. Each program standard for a postsecondary program includes the following elements:

- **Vocational standard** (the vocationally specific learning outcomes which apply to the program of instruction in question),
- **Essential employability skills** (the essential employability skills learning outcomes which apply to all programs of instruction), and
- **General education requirement** (the requirement for general education in postsecondary programs of instruction).

Collectively, these elements outline the essential skills and knowledge that a student must reliably demonstrate in order to graduate from the program.

Individual colleges of applied arts and technology offering the program of instruction determine the specific program structure, delivery methods, and other curriculum matters to be used in assisting students to achieve the outcomes articulated in the standard. Individual colleges also determine whether additional local learning outcomes will be required to reflect specific local needs and/or interests.

The Expression of Program Standards as Learning Outcomes

Learning outcomes represent culminating demonstrations of learning and achievement. They are not simply a listing of discrete skills, nor broad statements of knowledge and comprehension. In addition, learning outcomes are interrelated and cannot be viewed in isolation of one another. As such, they should be viewed as a comprehensive whole. They describe performances that demonstrate that significant integrated learning by graduates of the program has been achieved and verified.

Expressing standards as learning outcomes ensures consistency in the outcomes for program graduates, while leaving to the discretion of individual colleges curriculum matters such as the specific program structure and delivery methods.

The Presentation of the Learning Outcomes

The **learning outcome** statement sets out the culminating demonstration of learning and achievement that the student must reliably demonstrate before graduation.

The **elements of the performance** for each outcome define and clarify the level and quality of performance necessary to meet the requirements of the learning outcome. However, it is the performance of the learning outcome itself on which students are evaluated. The elements are indicators of the means by which the student may proceed to satisfactory performance of the learning outcome. The elements do not stand alone but rather in reference to the learning outcome of which they form a part.

The Development of a Program Standard

In establishing the standards development initiative, the Government determined that all postsecondary programs of instruction should include vocational skills coupled with a broader set of essential skills. This combination is considered critical to ensuring that college graduates have the skills required to be successful both upon graduation from the college program and throughout their working and personal lives.

A program standard is developed through a broad consultation process involving a range of stakeholders with a direct interest in the program area, including employers, professional associations, universities, secondary schools, and program graduates working in the field, in addition to students, faculty, and administrators at the colleges themselves. It represents a consensus of participating stakeholders on the essential learning that all program graduates should have achieved.

Updating the Program Standard

The Ministry of Training, Colleges and Universities will undertake regular reviews of the vocational learning outcomes for this program to ensure that the Computer Programmer Analyst Program Standard remains appropriate and relevant to the needs of students and employers across the Province of Ontario. To confirm that this document is the most up-to-date release, contact the Ministry of Training, Colleges and Universities at the address or telephone number noted on the inside cover page.

II. Vocational Standard

All graduates of Computer Programmer Analyst programs of instruction must have achieved the 11 vocational learning outcomes listed in the following pages, in addition to achieving the essential employability skills learning outcomes and meeting the general education requirement.

Preamble

Increasingly, individuals and organizations look to computers, be they stand-alone or networked, to optimize workflow, establish a presence in global markets, improve communication, and just generally improve productivity. This pervasive integration of computers and their associated technologies has led to a vast array of job opportunities in the creation, integration, and support of information technology.

Ontario colleges of applied arts and technology offer a wide variety of information technology programs that prepare graduates for both existing and emerging opportunities in our society. At the heart of the information technology education provided to Ontario college students is the ability to think critically, solve problems, and acquire new skills quickly. While these abilities are practised and enhanced in the context of a particular expertise, they are also transportable, with a reasonable training period, to other areas of expertise involving computers and their associated technologies.

Graduates of Computer Programmer Analyst Programs have honed their abilities, acquiring the expertise to design, test, and deploy integrated solutions. As such, graduates are able to work individually or as part of a team to assess business environments and justify solutions for the improvement or automation of organizational workflow that correspond to the day-to-day requirements of individuals and organizations. From developing and testing programs to ensuring secure implementation of solutions, graduates work in a broad range of employment settings in a variety of sectors in both large and small organizations.

While the vocational learning outcomes for programs, such as Computer Programmer Analyst, articulate the depth and breadth of skills, knowledge, and attitudes required by graduates when entering the work force, individual college programs may choose to build on this standard by offering some degree of specialization. Irrespective of the specialization, graduates' learning is significantly enhanced by opportunities for as much practical experience as is feasible during their time in the program.

There are many opportunities for graduates to pursue further educational qualifications; graduates may be granted credits towards a degree or certification through articulation agreements between the colleges and universities. Students should contact individual colleges for further details of a college's articulation agreements.

To be successful in an information technology environment requires an ongoing commitment from the graduate to continue to update his/her skills to stay current in this rapidly changing field. Making use of knowledge and experience gained during their studies, graduates may also choose to apply for professional designations from provincial, national, and international organizations as a further demonstration of their commitment to keep their skills current.

Synopsis of the Vocational Learning Outcomes
Cómputer Programmer Analyst Programs

The graduate has reliably demonstrated the ability to

1. **troubleshoot and document problems associated with software installation and customization.**

2. **analyze and define the specifications of a system based on requirements.**

3. **design, test, document, and deploy programs based on specifications.**

4. **apply knowledge of the design, modeling, implementation, and maintenance of a database.**

5. **apply knowledge of networking concepts to develop, deploy, and maintain programs.**

6. **propose and justify the design and development of an integrated solution based on an analysis of the business environment.**

7. **use relevant methodologies, policies, and standards to develop integrated solutions.**

8. **apply knowledge of security issues in the analysis, design, and implementation of integrated solutions.**

9. **develop and maintain effective working relationships with clients.**

10. **articulate, defend, and conform to workplace expectations found in information technology (IT) environments.**

11. **contribute to the successful completion of the project applying the project management principles in use.**

Note: The learning outcomes have been numbered as a point of reference; numbering does not imply prioritization, sequencing, nor weighting of significance.

The Vocational Learning Outcomes

1. *The graduate has reliably demonstrated the ability to*

troubleshoot and document problems associated with software installation and customization.

Elements of the Performance

- Assess the impacts of the environment (e.g., hardware, software, operating system) on the installation and customization of software
- Analyze problems associated with software installation and customization
- Formulate troubleshooting procedures taking into account the problem and the environment
- Research and determine feasible courses of action
- Document procedures and policies for keeping security software up-to-date
- Develop and follow appropriate methodologies to resolve problems effectively and minimize risk of recurrence
- Monitor, review, and assess the effectiveness of the troubleshooting procedure
- Document the troubleshooting procedure clearly
- Establish troubleshooting procedure, follow it, and explain it to others
- Identify impacts of installation and customization on stakeholders
- Use diagnostic software to determine the cause of problems

2. *The graduate has reliably demonstrated the ability to*

analyze and define the specifications of a system based on requirements.

Elements of the Performance

- Select and use appropriate methodologies for the analysis and design phases
- Conduct needs assessment and determine system requirements
- Summarize project background information
- Gather and document information from stakeholders and other sources
- Document and present the results of analysis and extract relevant requirements
- Summarize and organize information into systems specifications
- Verify and validate requirements regularly
- Perform a structured walkthrough
- Develop a test plan to verify requirements are met
- Document manual and computerized processes
- Incorporate confidentiality, integrity, and security of information policies and procedures in the specifications
- Assess alternative solutions and select the best solutions based on specifications
- Prepare accurate cost analysis of alternative solutions (e.g., "buy vs. build")
- Assess the impacts of replacing or integrating with the current system

3. *The graduate has reliably demonstrated the ability to*

design, test, document, and deploy programs based on specifications.

Elements of the Performance

- Apply knowledge of a variety of analysis, design, and development concepts and methodologies
- Use appropriate programming languages to develop and modify and integrate programs in different platforms
- Assess, select, and use appropriate tools and techniques to develop and maintain programs
- Minimize risk to clients when deploying programs
- Apply knowledge of a variety of techniques to test and debug programs
- Select appropriate testing methodologies based on specifications, and document results of tests
- Develop and organize integration testing
- Prepare and complete systems tests, including user acceptance tests
- Install, configure, and deploy programs
- Analyze, design, develop, and maintain effective user interfaces
- Prepare, present, and maintain current, clear, and accurate documentation

4. *The graduate has reliably demonstrated the ability to*

apply knowledge of the design, modeling, implementation, and maintenance of a database.

Elements of the Performance

- Apply knowledge of a variety of database types
- Apply knowledge of data structures to design a database
- Create a graphical representation of a database
- Apply knowledge of modeling methodologies
- Design, model, and implement a database
- Select and use appropriate tools and technologies to design and implement a database
- Design and implement user interfaces for databases that allow users to solicit, store, edit, and delete data
- Manipulate a database: create, read, update, and delete
- Address security and connectivity concerns, where applicable
- Recognize personal limits and seek assistance in a timely manner to resolve problems beyond own knowledge and skills
- Document the relationships within a database as well as the process by which relationships are changed
- Plan migration of data, where applicable
- Perform operations related to the maintenance of a database

5. *The graduate has reliably demonstrated the ability to*

apply knowledge of networking concepts to develop, deploy, and maintain programs.

Elements of the Performance

- Apply knowledge of a variety of computer architectures, platforms, and operating systems to resolve networking issues associated with program development, deployment, and maintenance
- Apply knowledge of client-server architecture and protocols to support the development, deployment, and maintenance of programs
- Apply knowledge of networking technologies to support programs used to foster and maintain e-business
- Apply knowledge of network and data security procedures and protocols when developing, deploying, and maintaining programs
- Use appropriate testing procedures for ensuring effective communication of programs in a networked environment, and document results
- Recognize the advantages and disadvantages of various network structures
- Integrate industry standard components into a system using third-party software tools
- Recognize the risk of data loss and data corruption in a networked environment
- Create a graphical representation of a network

6. *The graduate has reliably demonstrated the ability to*

propose and justify the design and development of an integrated solution based on an analysis of the business environment.

Elements of the Performance

- Apply knowledge of organizational behaviour to the analysis of the business environment
- Apply knowledge of financial and accounting principles to the analysis of the business environment
- Apply knowledge of human resources management to the analysis of the business environment
- Justify design and development proposal based on a return on investment analysis
- Seek out opportunities for business automation and optimization with or without the use of integrated solutions
- Address stated client requirements during the analysis of the business environment
- Develop tools for gathering required information to support design and development proposals
- Delegate data gathering responsibilities, where appropriate
- Conduct interviews
- Document and present results of the analysis and alternative solutions
- Develop solution prototypes
- Identify conflicting user requirements

7. *The graduate has reliably demonstrated the ability to*

use relevant methodologies, policies, and standards to develop integrated solutions.

Elements of the Performance

- Select and use an appropriate software development methodology
- Identify appropriate practices, processes, and procedures which ensure quality software development
- Complete all work in compliance with relevant standards, policies, processes, methodologies, and procedures
- Identify, select, and use various application architectures (e.g., web services vs. client services)
- Implement concurrent testing while developing solutions
- Prepare, present, and maintain current, clear, and accurate project-related documents which adhere to organizational and industry standards and procedures
- Participate in technical reviews
- Define and integrate quality assurance throughout the Software Development Life Cycle (SDLC)
- Modify development plans to allow for the incorporation of new and emerging technologies, where applicable.
- Perform quality assurance

8. *The graduate has reliably demonstrated.the ability to*

apply knowledge of security issues in the analysis, design, and implementation of integrated solutions.

Elements of the Performance

- Identify existing network and information security protocols and procedures in place
- Propose alternative security solutions, where appropriate
- Assess security risks created through the implementation or deployment of programs within an established and secure environment
- Contribute to the development of organizational policy pertaining to network and information security
- Minimize disruptions to clients workflow when implementing or updating integrated solutions
- Advocate the role of digital signatures and digital certificates in securing IT systems and solutions
- Recommend user-level and access-level classifications (e.g., user, administrator, privileged user)
- Communicate both the need for and the methods of security to the users

9. *The graduate has reliably demonstrated the ability to*

develop and maintain effective working relationships with clients.

Elements of the Performance

- Promote an environment of effective communication
- Respond to client inquiries promptly
- Maintain professional and honest relationships with clients
- Apply knowledge of organizational behaviour to the development of client relationships
- Ensure satisfactory realization of client's expectations
- Manage client expectations effectively
- Apply knowledge of client service to workplace interactions
- Measure client satisfaction
- Recognize the implications of non-disclosure agreements
- Apply knowledge of conflict resolution and facilitation skills

10. *The graduate has reliably demonstrated the ability to*

articulate, defend, and conform to workplace expectations found in information technology (IT) environments.

Elements of the Performance

- Recognize personal limits and seek assistance in a timely manner to resolve problems beyond own knowledge and skills
- Use language and terminology suited to the context
- Keep abreast of relevant technological change
- Adhere to and advocate ethical principles and standards
- Follow organizational policies and procedures and facilitate the communication of updates
- Use appropriate communication etiquette when using electronic technology
- Identify guidelines set by appropriate organizations and bodies that prescribe quality programs, practices, processes, and procedures which apply to information technology environments
- Ensure quality of assigned work
- Comply with software licensing requirements
- Make appropriate use of IT resources in the workplace
- Adhere to and advocate safe computing practices
- Participate in workplace mentoring programs
- Apply knowledge of existing confidentiality, privacy, and reporting regulations to daily work
- Function within the boundaries of established organizational policy, as well as legal and legislative requirements

11. *The graduate has reliably demonstrated the ability to*

contribute to the successful completion of the project applying the project management principles in use.

Elements of the Performance

- Participate in the planning, identification, scheduling, and assigning of tasks and resources involved in a project as required
- Contribute to the monitoring of resources and expenditures to maintain cost effectiveness and timelines as required
- Consolidate project updates regularly
- Estimate accurately the time required to complete project elements
- Complete project elements according to schedule
- Interpret and use project planning documents (e.g., Gantt Charts, Critical Path Analysis Charts, PERT Charts)
- Identify problems that will affect the project timeline and recommend changes as soon as possible
- Maintain current, clear, and accurate project-related documents which adhere to organizational and industry standards and procedures
- Use project management software

III. Essential Employability Skills

All graduates of Computer Programmer Analyst programs of instruction must have reliably demonstrated the essential employability skills learning outcomes listed on the following pages, in addition to achieving the vocational learning outcomes and meeting the general education requirement.

Context

Essential Employability Skills (EES) are skills that, regardless of a student's program or discipline, are critical for success in the workplace, in day-to-day living, and for lifelong learning.

The teaching and attainment of these EES for students in, and graduates from, Ontario's colleges of applied arts and technology are anchored in a set of three fundamental assumptions:

- These skills are important for every adult to function successfully in society today.
- Our colleges are well equipped and well positioned to prepare graduates with these skills.
- These skills are equally valuable for all graduates, regardless of the level of their credential, whether they pursue a career path, or they pursue further education.

Skill Categories

To capture these skills, the following six categories define the essential areas where graduates must demonstrate skills and knowledge.

- Communication
- Numeracy
- Critical Thinking & Problem Solving
- Information Management
- Interpersonal
- Personal

Application / Implementation

In each of the six skill categories, there are a number of defining skills, or sub skills, identified to further articulate the requisite skills identified in the main skill categories. The following chart illustrates the relationship between the skill categories, the defining skills within the categories, and learning outcomes to be achieved by graduates from all postsecondary programs of instruction that lead to an Ontario College credential.

EES may be embedded in General Education or vocational courses, or developed through discrete courses. However these skills are developed, all graduates with Ontario College credentials must be able to reliably demonstrate the essential skills required in each of the six categories.

SKILL CATEGORY	**DEFINING SKILLS: Skill areas to be demonstrated by graduates:**	**LEARNING OUTCOMES: The levels of achievement required by graduates. The graduate has reliably demonstrated the ability to:**
COMMUNICATION	• Reading • Writing • Speaking • Listening • Presenting • Visual literacy	1. *communicate clearly, concisely and correctly in the written, spoken, and visual form that fulfills the purpose and meets the needs of the audience.* 2. *respond to written, spoken, or visual messages in a manner that ensures effective communication.*
NUMERACY	• Understanding and applying mathematical concepts and reasoning • Analyzing and using numerical data • Conceptualizing	3. *execute mathematical operations accurately.*
CRITICAL THINKING & PROBLEM SOLVING	• Analysing • Synthesising • Evaluating • Decision making • Creative and innovative thinking	4. *apply a systematic approach to solve problems.* 5. *use a variety of thinking skills to anticipate and solve problems.*
INFORMATION MANAGEMENT	• Gathering and managing information • Selecting and using appropriate tools and technology for a task or a project • Computer literacy • Internet skills	6. *locate, select, organize, and document information using appropriate technology and information systems.* 7. *analyze, evaluate, and apply relevant information from a variety of sources.*

SKILL CATEGORY	DEFINING SKILLS: Skill areas to be demonstrated by graduates:	LEARNING OUTCOMES: The levels of achievement required by graduates. The graduate has reliably demonstrated the ability to:
INTERPERSONAL	• Team work • Relationship management • Conflict resolution • Leadership • Networking	8. *show respect for the diverse opinions, values, belief systems, and contributions of others.* 9. *interact with others in groups or teams in ways that contribute to effective working relationships and the achievement of goals.*
PERSONAL	• Managing self • Managing change and being flexible and adaptable • Engaging in reflective practices • Demonstrating personal responsibility	10. *manage the use of time and other resources to complete projects.* 11. *take responsibility for one's own actions, decisions, and consequences.*

IV. General Education Requirement

All graduates of Computer Programmer Analyst programs must have met the general education requirement described on the following pages, in addition to achieving the vocational and essential employability skills learning outcomes.

Requirement

The General Education Requirement for programs of instruction is stipulated in the Credentials Framework (Appendix A in the Minister's Binding Policy Directive *Framework for Programs of Instruction*).

While the inclusion of General Education is locally determined for programs of instruction leading to either a college certificate or an Ontario College Certificate, it is recommended that graduates of the Ontario College Certificate programs have been engaged in learning that incorporates some breadth beyond the vocational field of study.

In programs of instruction leading to either an Ontario College Diploma or an Ontario College Advanced Diploma, it is required that graduates have been engaged in learning that exposes them to at least one discipline outside their main field of study, and increases their awareness of the society and culture in which they live and work. This will typically be accomplished by students taking 3 to 5 courses (or the equivalent) designed discretely and separately from vocational learning opportunities.

This general education learning would normally be delivered using a combination of required and elective processes.

Purpose

The purpose of General Education in the Ontario college system is to contribute to the development of citizens who are conscious of the diversity, complexity, and richness of the human experience; who are able to establish meaning through this consciousness; and, who, as a result, are able to contribute thoughtfully, creatively, and positively to the society in which they live and work.

General Education strengthens student's essential employability skills, such as critical analysis, problem solving, and communication, in the context of an exploration of topics with broad-based personal and / or societal importance.

Themes

The themes listed below will be used to provide direction to colleges in the development and identification of courses that are designed to fulfil the General Education Requirement for programs of instructions.

Each theme provides a statement of Rationale and offers suggestions related to more specific topic areas that could be explored within each area. These suggestions are neither prescriptive nor exhaustive. They are included to provide guidance regarding the nature and scope of content that would be judged as meeting the intent and overall goals of General Education.

1. Arts in Society:

Rationale:
The capacity of a person to recognize and evaluate artistic and creative achievements is useful in many aspects of his/her life. Since artistic expression is a fundamentally human activity, which both reflects and anticipates developments in the larger culture, its study will enhance the student's cultural and self-awareness.

Content:
Courses in this area should provide students with an understanding of the importance of visual and creative arts in human affairs, of the artist's and writer's perceptions of the world and the means by which those perceptions are translated into the language of literature and artistic expression. They will also provide an appreciation of the aesthetic values used in examining works of art and possibly, a direct experience in expressing perceptions in an artistic medium.

2. Civic Life:

Rationale:
In order for individuals to live responsibly and to reach their potential as individuals and as citizens of society, they need to understand the patterns of human relationships that underlie the orderly interactions of a society's various structural units. Informed people will have knowledge of the meaning of civic life in relation to diverse communities at the local, national, and global level, and an awareness of international issues and the effects of these on Canada, and Canada's place in the international community.

Content:
Courses in this area should provide students with an understanding of the meaning of freedoms, rights, and participation in community and public life, in addition to a working knowledge of the structure and function of various levels of government (municipal, provincial, national) in Canada and/or in an international context. They may also provide an historical understanding of major political issues affecting relations between the various levels of government in Canada and their constituents.

3. Social and Cultural Understanding:

Rationale:
Knowledge of the patterns and precedents of the past provide the means for a person to gain an awareness of his or her place in contemporary culture and society. In addition to this awareness, students will acquire a sense of the main currents of their culture and that of other cultures over an extended period of time in order to link personal history to the broader study of culture.

Content:
Courses in this area are those that deal broadly with major social and cultural themes. These courses may also stress the nature and validity of historical evidence and the variety of historical interpretation of events. Courses will provide the students with a view and understanding of the impact of cultural, social, ethnic, or linguistic characteristics.

4. Personal Understanding:

Rationale:
Educated people are equipped for life-long understanding and development of themselves as integrated physiological and psychological entities. They are aware of the ideal need to be fully functioning persons: mentally, physically, emotionally, socially, spiritually, and vocationally.

Content:
Courses in this area will focus on understanding the individual: his or her evolution; situation; relationship with others; place in the environment and universe; achievements and problems; and his or her meaning and purpose. They will also allow students the opportunity to study institutionalized human social behaviour in a systematic way. Courses fulfilling this requirement may be oriented to the study of the individual within a variety of contexts.

5. Science and Technology:

Rationale:
Matter and energy are universal concepts in science, forming a basis for understanding the interactions that occur in living and non-living systems in our universe. Study in this area provides an understanding of the behaviour of matter that provides a foundation for further scientific study and the creation of broader understanding about natural phenomena.

Similarly, the various applications and developments in the area of technology have an increasing impact on all aspects of human endeavour and have numerous social, economic, and philosophical implications. For example, the operation of computers to process data at high speed has invoked an interaction between machines and the human mind that is unique in human history. This development and other technological developments have a powerful impact on how we deal with many of the complex questions in our society.

Content:
Courses in this area should stress scientific inquiry and deal with basic or fundamental questions of science rather than applied ones. They may be formulated from traditional basic courses in such areas of study as biology, chemistry, physics, astronomy, geology, or agriculture. As well, courses related to understanding the role and functions of computers (e.g., data management and information processing), and assorted computer-related technologies, should be offered in a non-applied manner to provide students with an opportunity to explore the impact of these concepts and practices on their lives.